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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/531,245	04/14/2005	John Joseph Senkevich	0094.074A	6502
23405 7590 07/21/2008 HESLIN ROTHENBERG FARLEY & MESTI PC 5 COLUMBIA CIRCLE ALBANY, NY 12203				
EXAMINER				
MALEKZADEH, SEYED MASOUD				
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1791				
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/531,245

Applicant(s)

SENKEVICH ET AL.

Examiner

SEYED M. MALEKZADEH

Art Unit

1791

Period for Reply -- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 27 March 2008.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,2 and 5-17 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,2 and 5-17 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-8508)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Response to Amendment

Claims 1-2 and 5-17 are pending.

Claims 3-4 are cancelled.

In view of the amendment, filed on 03/27/2008, following objections are withdrawn from the previous office action, mailed on 09/27/2007, for the reason of record.

- Objection of claims 4-6

Following rejections are maintained for the reason of record as given in the previous office action. The bases of these rejections are the same as given in the previous office action, mailed on 09/27/2007.

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claims 1-2, 5-8 and 12-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over DelaRosa et al (6,527,855) in view of Lopatin et al (US 6,482,656)

As to claims 1, 6-7, 12, and 16 DelaRosa et al ('855) disclose an atomic layer deposition (ALD) process comprised of depositing a layer from a

metallorganic precursor on a noble or semi-noble metal substrate. The metal of the deposited layer may be Pd, Rh, Ru, Pt, Ir, Ag, Au, Ni, Co, Fe and the substrate is a metal nitride or a metal oxide substrate (See lines 1-8, column 2). DelaRosa et al ('855) further disclose that the temperatures typically used is in a range from about 200° C to about 400° C. (See lines 51-52, column 3)

DelaRosa et al ('855) also teach that the ALD process is performed by sequentially pulsing a precursor vapor or gas, and a reducing agent gas into a chamber (See lines 8-12, column 3) which include a metal nitride or a metal oxide substrate (See lines 1-8, column 2)

Furthermore, as to claims 13-15 and 17, DelaRosa et al ('855) discloses the metallorganic precursor is composed of the metal and one or more ligands, wherein the ligand may be any bidentate ligand. The examples of precursors include acetylacetonate (acac) compounds, β -diketonate compounds such as metal β -diketonate compounds, 4-pentafluoro (hfa or hfac) compounds which includes metal-hfac compounds such as Pd(hfac)₂, Ru(hfac)₂, Rh(hfac)₂, Pt(hfac)₂, Ir (hfac)₂. (See lines 44-67, column 2).

As to claim 5, DelaRosa et al ('855) further teach that substrate surface was pretreated before deposition process by heating the substrate surface plate. (See lines 30-32, column 4). DelaRosa et al ('855) also disclose a substrate for the deposition may be any suitable substrate but in particular, may be tantalum (Ta), silicon, silicon dioxide or fluorinated silica glass. (See lines 19-25, column 4).

DelaRosa et al ('855) also teach the atomic layer deposition process is performed in the presence of a reducing agent such as hydrogen or a hydride. (See lines 1-4 and 16-19, column 2) However, DelaRosa et al ('855) fails to teach the reducing agent is a reducing gas selected from glyoxylic acid and imidazole.

In the analogous art, Lopatin et al ('656) teach a method of forming a superconducting damascene interconnect structure in which the method further include forming a cavity in an inter-level dielectric, and then forming a barrier layer in the cavity wherein the barrier layer is one or more of Ta, TaN, TaSiN, TiSiN, TiW, or WN. The barrier materials may also include cobalt (Co), nickel (Ni), palladium (Pd), molybdenum (Mo) and tungsten (W). (See lines 57-67, column 3 and lines 17-23, column 7).

Furthermore, Lopatin et al ('656) teach atomic layer deposition (ALD) as a metal deposition technique for deposition of barrier layer (See lines 31-37, column 10) wherein a reducing agent selected from glyoxylic acid and imidazole is provided in the process. (See lines 20-25, column 12)

Therefore, It would have been obvious for one of ordinary skill in the art at the time of applicant's invention to modify the atomic layer deposition process of DelaRosa et al ('855) by providing a reducing gas selected from glyoxylic acid and imidazole in the atomic layer deposition process chamber in order to improve the reducing process of metal ions to elemental state, and to eliminate impurities during ALD process, as suggested by Lopatin et al ('656).

Claims 9 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over DelaRosa et al ('855) and Lopatin et al ('656) as applied to claims 1-2 and 5-8 and 12-17 of above, and further in view of Pan et al (US 2003/0054149).

Combined teachings of DelaRosa et al ('855) and Lopatin et al ('656) disclose all the process limitations of an Atomic Layer Deposition (ALD) method as discussed above. However, DelaRosa et al ('855) and Lopatin et al ('656) do not teach about the use of an activated dielectric surface as a substrate wherein the activated dielectric comprises at least one of thiol, sulfide, tetra sulfide, phosphine, phosphide or amine groups as disclosed in claim 9, further they do not teach that the dielectric surface is selected from CVD polymers, organic-inorganic hybrids, and silicon or metals having an oxide terminated surface as disclosed in claim 11.

In the analogous art, Pan ('149) discloses a process for the fabrication of a porous coating on top of an open-structure substrate (See Paragraph [001]). Pan ('149) further discloses the open structure substrate coated by a metals oxide or sulfide (See paragraph [0016] and [0017]). Pan ('149) also teaches depositing a layer of catalytic coating on the porous coating surface, which is a metal oxide or metal sulfide as a substrate surface by ALD process (See paragraph [0025]).

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify the combined teachings of DelaRosa et al

('855) and Lopatin et al ('656) by providing a dielectric substrate surface such as sulfide and providing substrates having an oxide terminated surface as a dielectric substrate in order to minimize the electrical conductivity of the substrate surface used in ALD process because dielectric substrates have a high dielectric constants, as suggested by Pan et al ('149).

Claims 9 and 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over DelaRosa et al ('855) and Lopatin et al ('656) as applied to 1-2 and 5-8 and 12-17 of above, and further in view of Senkevich et al. (US 2002/0182385)

Combined teachings of DelaRosa et al ('855) and Lopatin et al ('656) disclose all the process limitations of an atomic layer deposition (ALD) process as discussed above. However, DelaRosa et al ('855) and Lopatin et al ('656) do not teach the dielectric surface comprises one of thiol, sulfide, tetrasulfide, phosphine, phosphide or amine groups, as disclosed in claim 9 and further they do not teach dielectric surface comprises thiol groups, as claimed in claim 10.

In the analogous art, Senkevich et al. ('385) teaches a method for metallizing a substrate by depositing a metallic thin film over the substrate surface by atomic layer deposition (ALD) process wherein the method includes providing a precursor for an element selected from the group consisting of sulfur, selenium, tellurium, phosphorus, antimony, iodine and bromine which is deposited directly on the surface of the substrate. Further, an atomic

passivation layer comprising at least one of said elements, and then forming the layer directly on the atomic passivation layer. (See paragraph [0031]).

Applicant attention is drawn to this point that according to Britannica Encyclopedia Mercaptan is also known as thiol (See Britannica Online Encyclopedia, <<http://www.britannica.com/eb/article-9072136>> for Thiol).

The substrate may be a dielectric material, or a diffusion barrier material, and may be composed of ceramic materials having an oxide surface, organic polymers, or organic/inorganic hybrid materials. (See paragraph [0031])

Senkevich et al. ('385) further teach a monolayer mercaptan SAM from a starting chemical material can form a one-monolayer thick film on dielectric or diffusion barrier material (See paragraph [0052] and [0059]). Mercaptan is another name for thiol.

Further Senkevich et al. ('385) teach the monolayer mercaptan SAM grows rapidly to one monolayer and then will grow multilayer films, at times approximately 60 minutes. Further, mercaptan monolayer has a higher packing density. (See paragraph [0068])

Therefore, it would have been obvious for one of ordinary skill in the art at the time of applicants' invention to modify the method of DelaRosa et al ('855) and Lopatin et al ('656) by providing a dielectric surface comprises thiol group because the thiol layer grows rapidly to one monolayer and further thiol has a higher packing density, as suggested by Senkevich et al. ('385).

Response to Arguments

Applicants' arguments filed on 03/27/2008, have been fully considered but they are not persuasive.

Applicants argue that there is no requisite motivation supporting the modification proposed by the examiner as neither DelaRosa et al nor Lopatin et al provides a basis for the modification. Furthermore, applicants argue that DelaRosa et al. does not disclose the use of a reducing agent selected from glyoxylic acid and/or imidazole as acknowledged by the examiner. Thus, DelaRosa et al. does not provide a basis to modify the process steps disclosed therein to include the step of preparing a barrier layer comprising Ta, TaN, TaSiN, TiW, or Wn, and alloys such as NiW, NiTa, NiMo, CoW, CoW, CoTa, CoMo, PdW, PdTa, PdMo, CuBa, and CuBaO, and then exposing the foregoing to a non-gaseous reducing agent selected from glyoxylic acid and/or imidazole as disclosed in the Lopatin et al. Also, Lopatin et al. does not provide a basis for modifying DelaRosa et al. to include pulsing in a reducing gas selected from glyoxylic acid and/or imidazole so as from a layer comprising a metal selected from Pd, Rh, Ru, Pt, and Ir as neither of the foregoing are taught or suggested in Lopatin et al. (See lines 11-23, page 7 and lines 4-7, page 8)

This is not found persuasive because combined teachings of DelaRosa et al in view of Lopatin et al. clearly teach a basis for providing a reducing agent selected from glyoxylic and/or imidazole in the atomic layer deposition process. DelaRosa et al ('855) teaches the atomic layer deposition process is performed

in the presence of reducing agents such as oxidizing agent and hydrogen or hydride. (See lines 1-4 and 16-19, column 2) Therefore, DelaRosa clearly provide a base of providing a reducing agent for the claimed atomic layer deposition process. However, DelaRosa et al ('855) fails to teach the reducing agent is a reducing gas selected from glyoxylic acid and imidazole. In the same technology, Lopatin et al ('656) teach an atomic layer deposition (ALD) as a metal deposition technique for deposition of barrier layer (See lines 31-37, column 10) wherein the ALD process performed in the presence of a reducing agent selected from glyoxylic acid and imidazole. (See lines 20-25, column 12) Therefore, it would have been obvious for one of ordinary skill in the art to combine the teachings of DelaRosa et al ('855) and Lopatin et al ('656) to provide a reducing gas selected from glyoxylic acid and imidazole in the ALD process chamber in order to improve the reducing process of metal ions to elemental state, and to eliminate impurities during ALD process which is a strong and proper conclusion of obviousness within the knowledge of ordinary skill in the art.

Furthermore, applicants argue that there is nor requisite motivation supporting the modification of DelaRosa et al. with Lopatin et al. as the examiner is drawing a conclusion of obviousness from the applicants' specification. It is improper, in determining whether a person of ordinary skill would have been led to this combination of references, simply to "[use] that which the inventor taught against the teacher." (See lines 8-12, page 8)

This is not found persuasive because it was not found anywhere in the disclosure of the instant application the support for the applicant's argument in which the conclusion of obviousness was drawn from the applicants' disclosure. The motivation for the combining DelaRosa et al and Lopatin et al under 103(a) rejection is "providing a reducing gas selected from glyoxylic acid and imidazole in the process chamber in order to improve the reducing process of metal ions to elemental state, and also to eliminate impurities during ALD process" which is not found in the disclosure of the applicant's disclosure. Furthermore, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). Also, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971). Moreover, under the correct analysis, any need or problem known in the field of endeavor at the time of the invention and addressed by

the patent [or application at issue] can provide a reason for combining the elements in the manner claimed. ” KSR International Co. v. Teleflex Inc., 550, 82 USPQ2d 1385, 1397 (2007). (See MPEP 2141.01(a) [R-6])

In respect to claims 9 and 11, applicants argue that Pan et al. (US 2003/0054149) does not disclose the use of a reducing gas selected from glyoxylic acid and imidazole, or provide motivation to make such a modification to either of DelaRosa et al. or Lopatin et al. (See last paragraph of page 9, lines 9-12)

However, this is not found persuasive because applicant's attention is drawn to the point that the combination of Pan et al. (US 2003/0054149) with the combined teachings of DelaRosa et al. and Lopatin et al. to reject claims 9 and 11 has not been implemented to remedy the deficiency of the providing a reducing gas selected from glyoxylic acid and imidazole since the combined teachings of DelaRosa et al. and Lopatin et al. teach all the claim limitations such as providing a reducing gas selected from glyoxylic acid and imidazole for an ALD process as claimed in claims 1-2, 5-8, and 12-17. However, Pan et al. (US 2003/0054149) in combined with combined teaching of DelaRosa et al. and Lopatin et al. teach the step of providing a dielectric substrate surface such as sulfide and also providing substrates having an oxide terminated surface as a dielectric substrate in order to minimize the electrical conductivity of the substrate surface used in ALD process because the dielectric substrates have a high dielectric constant.

In respect to claims 9 and 10, applicants argue that Senkevich et al. (US 2002/0182385) does not disclose the use of a reducing gas selected from glyoxylic acid and imidazole, or provide motivation to make such a modification to either of DelaRosa et al. or Lopatin et al. (See page 10, third paragraph , page 10, lines 9-12)

However, this is not found persuasive because applicant's attention is drawn to the point that the combination of Senkevich et al. (US 2002/0182385) with the combined teachings of DelaRosa et al. and Lopatin et al. to reject claims 9 and 10 has not been implemented to remedy the deficiency of providing a reducing gas selected from glyoxylic acid and imidazole for an atomic layer deposition process since the combined teachings of DelaRosa et al. and Lopatin et al. teach all the claimed limitations such as providing a reducing gas selected from glyoxylic acid and imidazole for an ALD process as claimed in claims 1-2, 5-8, and 12-17. However, Senkevich et al. (US 2002/0182385) in combined with combined teaching of DelaRosa et al. and Lopatin et al. teach the step of providing a dielectric substrate surface comprising a thiol group since the thiol layer grows rapidly to one monolayer and further thiol has a higher packing density, as suggested by Senkevich et al. (US 2002/0182385)

Therefore, claims 1-2 and 5-17 maintained rejected.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Seyed Masoud Malekzadeh whose telephone number is 571-272-6215. The examiner can normally be reached on Monday – Friday at 8:30 am – 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Steven P. Griffin, can be reached on (571) 272-1189. The fax number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published application may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/S. M. M./

Examiner, Art Unit 1791

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/Philip C Tucker/

Supervisory Patent Examiner, Art Unit 1791